

This Page Is Inserted by IFW Operations
and is not a part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

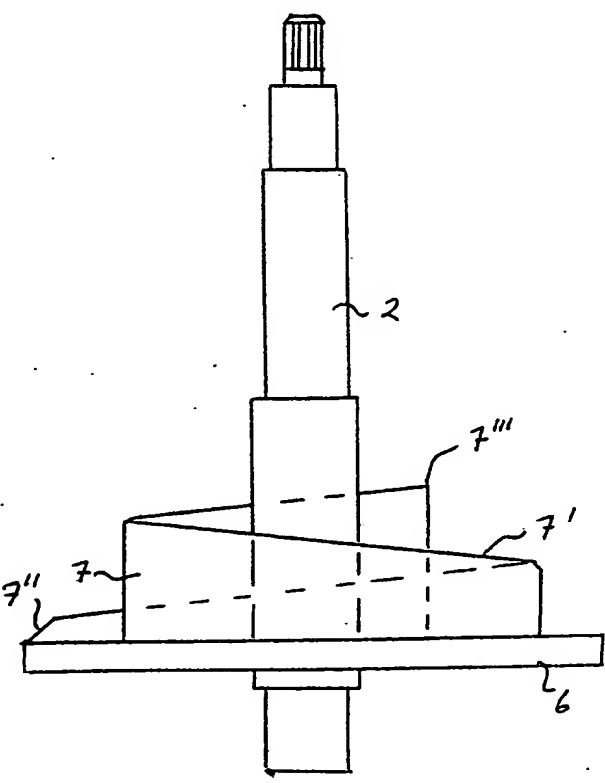
- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

**As rescanning documents *will not* correct images,
please do not report the images to the
Image Problem Mailbox.**

PCTWORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ³ : B27L 11/00	A1	(11) International Publication Number: WO 84/02871 (43) International Publication Date: 2 August 1984 (02.08.84)
<p>(21) International Application Number: PCT/FI84/00008</p> <p>(22) International Filing Date: 23 January 1984 (23.01.84)</p> <p>(31) Priority Application Number: 830202</p> <p>(32) Priority Date: 21 January 1983 (21.01.83)</p> <p>(33) Priority Country: FI</p> <p>(71)(72) Applicant and Inventor: VUOLLET, Martti [FI/FI]; SF-61800 Kauhajoki (FI).</p> <p>(74) Agent: OY JALO ANT-WUORINEN AB; Laivurinne 2 A 6, SF-00120 Helsinki (FI).</p> <p>(81) Designated States: AT (European patent), CH (European patent), DE (European patent), DK, FR (European patent), NO, SE (European patent).</p>		<p>Published <i>With international search report.</i> <i>In English translation (filed in Finnish).</i></p>
<p>(54) Title: CHIPPER</p> <p>(57) Abstract</p> <p>A chipper in particular for the chipping of small-size thinning wood or slender trees. The chipper consists of basic components in themselves known, feed members for the small-size wood to be fed in, of a chipping member supported by the shaft that receives the operating power, as well as of members for the removal of the chips, such as of a system of blower wings supported and rotated by the said shaft as well as of an exhaust tube. In the chipper in accordance with the invention, the chipping member is constructed in an original way so that the good self-feeding quality of the chipping member has been retained, but the chipping member has a robust construction, and it permits feeding of the wood to be chipped from the side of the chipper. The said properties have been obtained so that the chipping blade of the chipping member consists of at least one continuous blade (7) projecting substantially perpendicularly from the plane of the blade disc (6) in the direction of the shaft (2), that the blade approaches the centre of the disc from the circumference of the disc as spiral-shaped in the direction of rotation of the disc, and that the perpendicular distance of the cutting edge (7') of the blade from the plane of the disc increases as screw-shaped as the blade approaches the central area of the disc.</p> 		

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	KR	Republic of Korea
AU	Australia	LI	Liechtenstein
BE	Belgium	LK	Sri Lanka
BG	Bulgaria	LU	Luxembourg
BR	Brazil	MC	Monaco
CF	Central African Republic	MG	Madagascar
CG	Congo	MR	Mauritania
CH	Switzerland	MW	Malawi
CM	Cameroon	NL	Netherlands
DE	Germany, Federal Republic of	NO	Norway
DK	Denmark	RO	Romania
FI	Finland	SD	Sudan
FR	France	SE	Sweden
GA	Gabon	SN	Senegal
GB	United Kingdom	SU	Soviet Union
HU	Hungary	TD	Chad
JP	Japan	TG	Togo
KP	Democratic People's Republic of Korea	US	United States of America

Chipper

The present invention is concerned with a chipper for the chipping of wood. In particular, the
5 chipper in accordance with the invention is suitable for chipping of slender trees. Such slender trees are harvested in connection of thinning and cleaning of forests, and such wood is usually of excessively little
10 dimensions to be used for any other purpose except for firewood. This is why it is preferable that the wood material is recovered as completely as possible, i.e. including the twigs, leaves, and needles.

For the chipping of the wood material mentioned above, different types of chippers have been used
15 and developed, the oldest ones of them being direct applications of lath chippers used at sawmills. Lath chippers are, however, not very well suitable for the said purpose, for the construction of their chipping member usually requires forced feeding of the lumber to
20 be chipped. Separate forced-feeding devices make the chipper unnecessarily heavy for cross-country conditions, e.g., for operation by means of an ordinary agricultural tractor. On the other hand, the chipping member of these chippers has been planned for chipping
25 of raw-material suitable for pulp mills, i.e. of chips of relatively little dimensions. The chips of the said sort are not very well suitable, e.g., for grate boilers, because the small-size chips are packed on the grate as a dense heap, through which the combustion
30 air cannot penetrate to a sufficient extent.

By means of more recent chipper developments, it has been possible essentially to eliminate these deficiencies, in which developments the chipping member
35 itself is of such a construction that it produces efficient feeding of the lumber. By means of these chippers, it is also possible to chip the wood to chips of larger size, of about 5 cm dimension, which



might also be termed as small firewood chunks. The production of chips of larger size has been permitted thereby that the chips chopped off are not removed through blade openings in the chipper disc, but the chips chopped off remain in connection with the blade members and are removed through relatively spacious passage openings independent from the chipping member.

A chipper of this kind is described in the Finnish Patent Application No. 81,2009. In this prior-art chipper construction, the chipper member consists of a cutter blade as screw-shaped surrounding the shaft that receives the operating power, the perpendicular distance of the said blade from the shaft increasing in the direction of feed of the wood. Under these circumstances, the cutter blade forms a spiral cone expanding in the direction of feed of the wood, the sharpened outer edge of the said spiral cutting through the wood by pressing it against a guide formed into the feed trough. By means of the spiral construction of the cutter blade, a good feed of the wood has been achieved, and no separate members are required for this purpose.

However, it can be considered an essential drawback of a spiral chipper of this type that therein the cutting blade runs in the same cutting track from the beginning of the cutting process right to the end, penetrating deeper into the wood as the diameter of the cutting spiral increases, i.e. the cutting movement of the cutter blade becomes substantially perpendicular to the longitudinal axis of the wood. Thereby, as the cutting makes progress, the blade is wedged ever more tightly into the cutting groove and causes a very steep increase in the requirement of power. The wedging situation goes on until the wedge effect of the blade produces a sufficiently great longitudinal power component in the wood, which component cleaves a piece of chips apart. Thereupon the cutting goes on at the



said cutting point until the next cleavage process.
In the said Patent Application No. 81,2009, attempts
have been made to reduce the wedging of the blade into
the wood and, correspondingly, a sudden increase in the
5 power requirement, so that the inclination of the cutting
edge of the blade spiral relative the cutting direction
perpendicular to the longitudinal axis of the wood has
been made such that it increases in the direction of
feed of the wood, i.e. in the direction of progress of
10 the cutting. By means of this constructional solution,
a prying effect has been produced for the blade in the
cutting groove in the longitudinal direction of the
wood as the blade penetrates deeper into the wood as the
cutting makes progress, which prying effect causes a
15 cleavage apart of a chip earlier than what would be the
case with a wedge effect of the blade alone.

In the said constructional solution, when the
blade pries the chip piece apart, the rear portion of
the blade is supported against the corresponding wall
20 of the cutting groove, whereby it produces a strong
rubbing resistance and, at the same time, overrules the
power component of the blade tip in the longitudinal
direction of the wood, which component cleaves the chip
apart and feeds the wood forwards. In practice, it has
25 also been noticed that, when slender trees are chipped
by means of the said prior-art chipper type, the
trees tend to jump around extensively in the feed
funnel, which causes a safety risk for the operator
of the machine. The strong transverse and rotating
30 effects caused on the trees to be chipped are obviously
attributable to the basic construction of the device,
according to which construction, during cutting, the
blade is a tangent to the tree in accordance with the
curve radius of the spiral edge at each particular time,
35 i.e., in a way, scrapes the tree constantly at a very
steep angle. It should be noticed further that the
curve form of this scraping track, i.e. bottom of the



cutting groove, increases throughout the entire cutting operation, whereat the maximum cutting load is directed at the initial and final ends of the cutting groove, which may have its effect on the instability of the cutting operation. The inventor who developed the chipper type described above has also recognized this problem himself by developing the chipper in the way described in the Patent Application No. 81,2135, i.e. by designing the chipping member of the chipper as a double screw spiral. The said solution has obviously a favourable effect on the cutting process, because there are, at one time, two blades in contact with the wood at different portions of the wood. The other drawbacks of the chipper described above are, however, retained in this developed version as well.

By means of the chipper construction in accordance with the present invention, a chipper has been provided which is particularly well suitable for the chipping of slender trees, in which the automatic feed of the wood is highly efficient, in which the trees have a steady behaviour throughout the entire cutting process, and by means of which the chipping can be achieved with a lower power requirement as compared with the prior-art chippers. The chipper in accordance with the invention, which, in a way in itself known, comprises feeding members, such as a trough for feeding the wood to be chipped, a chipping member supported and rotated by the shaft receiving the operating power, as well as, preferably, members for the removal of the chips, such as a blower supported and driven by the said shaft, as well as an exhaust tube, and in which chipper the chipping member consists of a blade disc, which is mounted perpendicularly and centrally on a shaft, as well as of a chipping blade or blades mounted on the blade disc, is characterized in that the chipping blade consists of at least one continuous blade projecting



substantially perpendicularly from the plane of the blade disc in the direction of the shaft, that the blade approaches the centre of the disc from the circumference of the disc as spiral-shaped in the direction of rotation of the disc, and that the perpendicular distance of the cutting edge of the blade from the plane of the disc increases as screw-shaped as the blade approaches the central area of the disc.

The invention will be described with the aid of the attached drawing, wherein

Figure 1 shows a chipper in accordance with the invention as viewed from above, partly in section,

Figure 2 shows the chipping member of the chipper as mounted on the drive shaft,

Figure 3 shows the chipping member as viewed out of the direction of introduction of the drive power for the shaft,

Figure 4 shows a detail of the relative fitting between the final cutting edge of the blade and the counter-blade formed into the feed tube, as seen perpendicularly to the direction of the drive shaft, and

Figure 5 shows a detail of the portion in the side wall of the feed tube at which the counter-blade of the final cutting edge of the cutting blade has been formed.

In respect of its basic construction, the chipper shown in Fig. 1 is in itself known, i.e. it comprises a tube-shaped or trough-shaped feeding member 1 for feeding the wood to be chipped, a chipping chamber, in which the chipping member 3 supported by the driven shaft 2 performs the chipping of the wood fed in as well as feeds the wood further to the chip-removing members. The removing members preferably consist of a blower unit 4 supported and driven by the same shaft 2 as well as of an exhaust tube 5 guiding the out-coming chip flow.



The chipping member 3 consists of a blade disc 6, which is mounted on the drive shaft 2 centrally and perpendicularly to the shaft. The blade 7 that performs the cutting is formed as a spiral mounted on the blade disc, at which spiral the edge projecting from the blade disc is sharpened as a cutting edge 7'. The blade spiral projects as substantially perpendicular from the face of the blade disc, i.e. as substantially parallel to the drive shaft 2. The blade spiral 7 starts from the circumference of the blade disc and approaches the centre of the blade disc as spiral-shaped, preferably to a distance that is about 1/4 of the diameter of the blade disc. At the same time, the cutting edge of the blade spiral becomes more distant from the face of the blade disc as screw-shaped to a distance corresponding to a full cutting stroke, i.e. to a distance at which the cutting edge meets the wall plane of the feed trough.

The length of the blade spiral and, at the same time, also the thread-shaped pitch of its cutting edge have been selected so that the blade performs a full cutting stroke during about $1\frac{1}{2}$ revolutions of the blade disc. Thereby, the blade starts a new cutting operation before the preceding cutting operation has been completed, which stabilizes the cutting process and ensures continuous and undisturbed feed of the wood. By means of the said blade length, the masses of the blade have also become dynamically substantially balanced.

In view of aspects of strength and of smooth starting of the cutting operation, it is advantageous that a starting edge 7" of steeper pitch is formed at the beginning of the steel spiral, which starting edge begins the cutting of the log by striking a starting cut into it, into which said starting cut the blade edge 7' proper then cuts in. In the dimensioning of the blade, the dynamic balance of the blade device



must, of course, also be taken into account, for the machine will revolve at quite a high speed of revolution, which, as attached directly to the power take-off of a tractor, will be about 540 rpm.

5 In view of smooth finishing of the cutting operation and in view of complete cutting of twigs and other thin parts of trees, it is advantageous to provide the feed trough with a curved counter-blade groove 8, in which the final edge of the cutting blade 7
10 runs to produce a shear-like finishing cutting for each cutting cycle. The said counter-blade groove preferably extends across the entire feed trough, as is shown in Fig. 5.

Fig. 5 also shows the grooves 9 formed in the
15 feeding direction in the side wall of the end portion 1' of the trough 1 at the side of the final cutting counter-blade 8, the objective of the said grooves being to guide the trees to be chipped so that they should not be turning at the final stage of the chipping.
20 The said grooves may, of course, be replaced by corresponding ribs.

It has been noticed in practice that the chipper in accordance with the invention operates very smoothly, i.e. the feeding of the wood into the chipper
25 takes place at a uniform speed and efficiently, without any tendency of the trees to toss around at any stage of chipping. Moreover, it has been noticed that the power requirement with a chipper in accordance with the invention, when chipping a tree of equal thickness, is
30 lower than when prior-art chippers are used. It can be considered that the favourable effects mentioned above are derived from the favourable cutting operation of the chipping member used in the chipper in accordance with the invention. The low consumption of power and
35 the efficient feed are obviously mainly caused by the spiral form of the blade. According to the invention, when the steel spiral accomplished in the chipping



member bites itself in accordance with the pitch of the screw line of the cutting edge transversely into the wood, the blade becomes more steeply curved, as the spiral becomes narrower, in the longitudinal direction of the wood, whereat the blade presses the chip piece being cut apart in the transverse direction by means of the steepening inner portion of the blade in the feeding direction of the wood, which results in an increasing power component in the longitudinal direction of the wood in the direction cleaving the chip particle apart. The said longitudinal power component essentially contributes to the detaching of the chip particle, whereat the distance of cutting of the blade edge into the wood at each particular time remains short, as a result of which there is also a low rubbing-friction effect. Moreover, this power component acts in the feeding direction of the wood and aids in the feeding of the wood, without any counter-component overruling this power component occurring in the cutting process, for the outer edge of the blade becomes constantly more distant from the corresponding edge of the cutting groove and, consequently, does not cause a rubbing resistance against this edge.

Another essential factor that contributes to the steady behaviour of the wood in the chipper is the fact that the cutting blade is a tangent to the log at a substantially little angle, which corresponds to the pitch angle of the screw line of the cutting edge, and not to the curve radius of the screw, as is the case in a prior-art spiral chipper.

It is another significant advantage of the chipper in accordance with the present invention as compared with a prior-art chipper that the construction of the chipper member is essentially more advantageous in respect of the strength and the manufacture of the chipping member.



As an alternative for the embodiment shown in the figures, the invention may also be accomplished by forming the blade 7 as a double spiral, which is placed on the blade disc 6 as of different phases.

- 5 The double spiral gives better possibilities for making the choice between the desired chip size and the diameter of the blade disc of the chipper.



WHAT IS CLAIMED IS:

1. Chipper, in particular a chipper for slender trees, which comprises feeding members, such as a trough (1) for feeding the wood to be chipped, a chipping member (3) supported and rotated by the shaft (2) receiving the operating power, as well as, preferably, members for the removal of the chips, such as a blower (4) supported and driven by the said shaft (2), as well as an exhaust tube (5), and in which chipper the chipping member (3) consists of a blade disc (6) which is mounted perpendicularly and centrally on the shaft (2), as well as of a chipping blade or blades mounted on the blade disc, characterized in that the chipping blade consists of at least one continuous blade (7) projecting substantially perpendicularly from the plane of the blade disc (6) in the direction of the shaft (2), that the blade approaches the centre of the disc from the circumference of the disc as spiral-shaped in the direction of rotation of the disc, and that the perpendicular distance of the cutting edge (7') of the blade from the plane of the disc increases as screw-shaped as the blade approaches the central area of the disc.
2. Chipper as claimed in claim 1, characterized in that the blade spiral (7) revolves about $1\frac{1}{2}$ revolutions around the centre of the blade disc (6).
3. Chipper as claimed in claim 1 or 2, characterized in that the initial end of the blade (7) is provided with a stroke-cutting edge (7").
4. Chipper as claimed in any of the preceding claims 1 to 3, characterized in that the final end of the blade (7) is provided with a cut-off edge (7''').



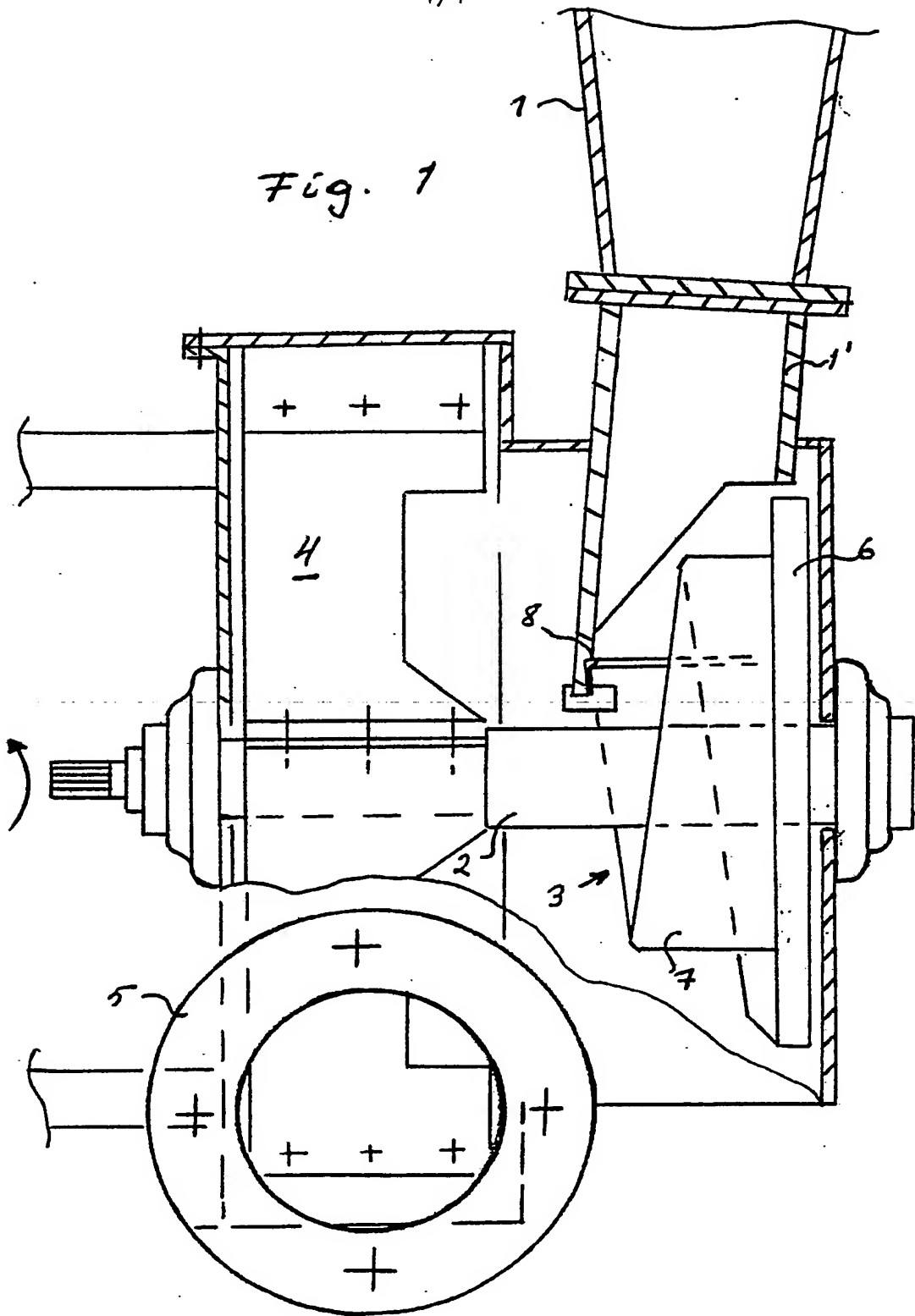
5. Chipper as claimed in any of the preceding claims 1 to 4, characterized in that the blade (7) is accomplished as a double spiral which is mounted on the blade disc (6) as of different phases.

5



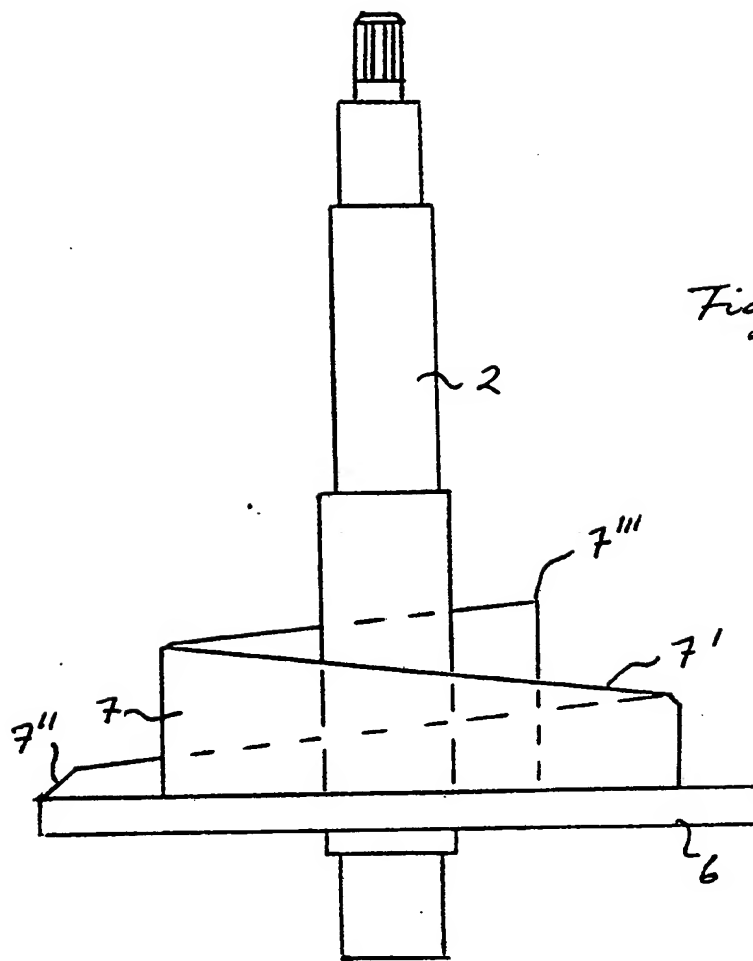
1/4

Fig. 1



SUBSTITUTE SHEET





SUBSTITUTE SHEET



3/4

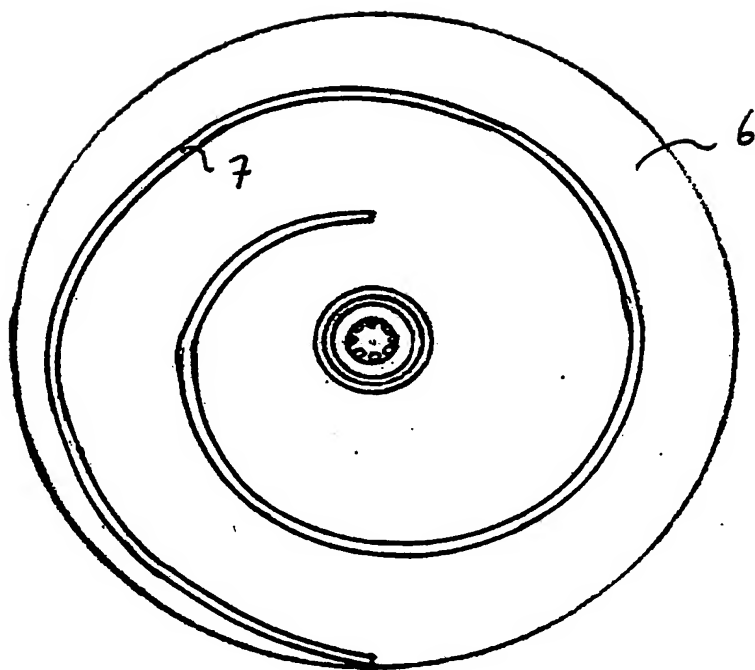
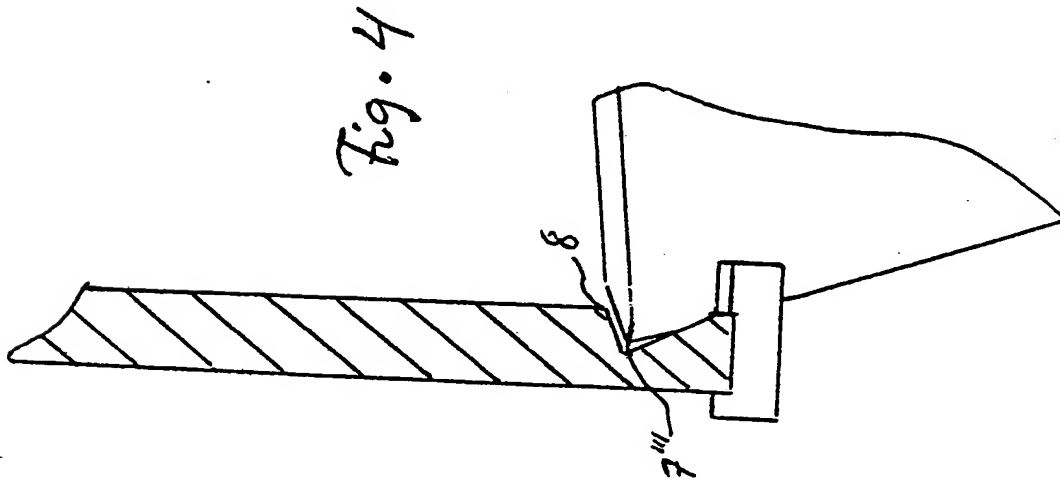
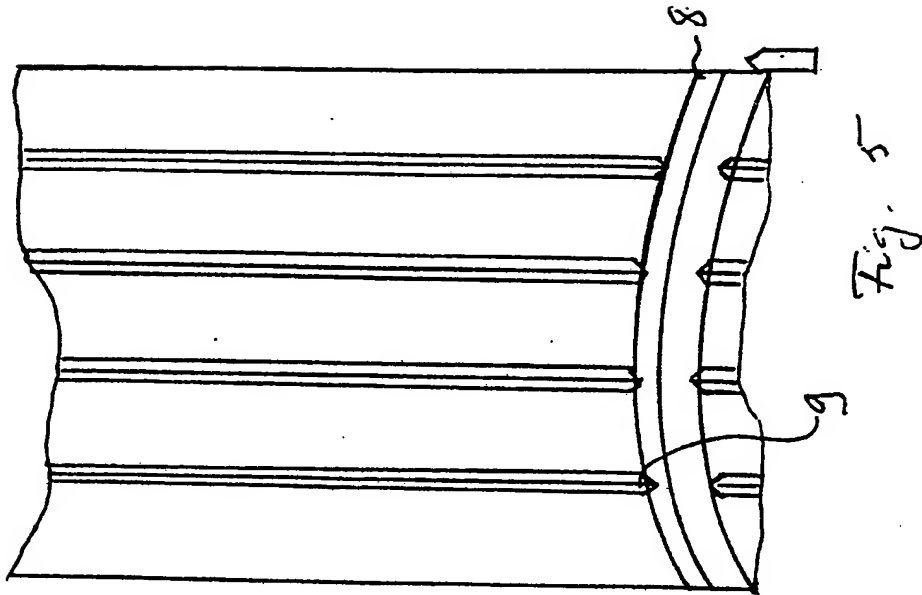


Fig. 3

SUBSTITUTE SHEET



6/6




SUBSTITUTE SHEET



INTERNATIONAL SEARCH REPORT

International Application No PCT/FI84/00008

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC ³		
B 27 L 11/00		
II. FIELDS SEARCHED		
Minimum Documentation Searched *		
Classification System	Classification Symbols	
IPC 3	B 27 L 11/00, 02; B 27 G 13/00, 02, 08; B 02 C 18/40; D 21 B 1/00-1/04, 1/34	
National C	38i:4; 38e:1; 55a:3/40, 5/01 .../...	
Documentation Searched other than Minimum Documentation to the extent that such Documents are included in the Fields Searched *		
SE, NO, DK, FI classes as above		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴		
Category *	Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸
A	SE, B, 339 389 (KOCKUM-SÜDERHAMN AB) 21 June 1970	1-5
Y	DE, B, 1 207 205 (GRUBBENS & CO AB) 16 December 1965	1-5
Y	DE, C, 3 027 044 (J.M. VOITH, GMBH) 4 February 1982 & GB, 2080146 JP, 57077384 FR, 2493364 DE, 3123288 US, 4413789	1-5
A	GB, B, 1 361 953 (EISHIN, KK) 24 January 1973	1-5
A	EP, A, 0 019 092 (KOPO-KONEPOHJA OY) 17 April 1980	1-5
Y	US, A, 4 301 846 (TORSTEN. L. BERGREN) 24 November 1981 & DE, 3011723 GB, 2048115 .../...	1-5
<p>* Special categories of cited documents: ¹⁵</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search ¹	Date of Mailing of this International Search Report ²	
1984-04-17	1984-04-26	
International Searching Authority ¹	Signature of Authorized Officer ¹⁰	
Swedish Patent Office	Eddy Leopold  L.E.	

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

II Fields searched (cont.)

US C1 144:162-180, 218-241, 32c;
241:55-57, 79, 92, 101.7, 278, 298

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE ¹⁰

This International search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers because they relate to subject matter ¹² not required to be searched by this Authority, namely:
2. ☐ Claim numbers because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out ¹³, specifically:

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING ¹¹

This International Searching Authority found multiple inventions in this International application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International search report covers all searchable claims of the international application.
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this International search report covers only those claims of the international application for which fees were paid, specifically claims:
3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:
4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No ¹⁸
Y	JP, 55128406 SE, 425953 SE, 7902738	
A	US, A, 4 053 004 (R.D. BARWISE, R.A. AROLA, J.R. ERICKSON) 11 October 1977	1-5
A	US, A, 2 889 859 (D.L. JOHNSON) 9 June 1959	1-5